

Catalogue no. 11F0019M — No. 345
ISSN 1205-9153
ISBN 978-1-100-21213-5

Research Paper

Analytical Studies Branch Research Paper Series

Certification, Completion, and the Wages of Canadian Registered Apprentices

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Ottawa, Ontario

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October 2012

Published by authority of the Minister responsible for Statistics Canada

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La version française de cette publication est disponible (n° 11F0019M au catalogue, n° 345).

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Acknowledgments

Thanks to Louise Desjardins, of Statistics Canada, Benoit Dostie, of HEC Montréal, Torben Drewes, of Trent University, and Kathryn McMullen, of Statistics Canada, for providing useful comments on an earlier draft of this paper. Conference participants at the Canadian Economic Association Conference and at Statistics Canada's Socio-Economic Conference also provided useful comments. Most of the work on this paper was completed while Richard E. Mueller was a visiting fellow in the Social Analysis Division of Statistics Canada.

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Abstract

Using the 2007 National Apprenticeship Survey (NAS), this research paper estimates the earnings functions of individuals who completed or discontinued a registered apprenticeship program. Controlling for observed demographic, labour market, and employer characteristics correlated with the two apprenticeship states, it finds earnings differences of approximately 20%. The paper also disaggregates apprentices into four groups on the basis of program completion and certification in order to refine the wage comparisons.

Related studies on [education and training](#) and [income and wealth](#) from the Social Analysis Division can be found at [Update on Social Analysis Research](#).

Executive summary

Between 1995 and 2007, the number of Canadians enrolled in apprenticeship programs more than doubled, from 163,370 to 358,555. However, over the same period the number of successful apprenticeship completions increased by only about one-third, raising questions about what might account for the widening gap. The earnings gains associated with apprenticeship completion is one consideration. Certification is also an important consideration in the discussion of wages earned by apprentices.

This study uses the 2007 National Apprenticeship Survey (NAS) to compare hourly wage differences observed between apprentices who complete their programs and apprentices who discontinue their programs. The primary objective is to estimate the magnitude of the wage difference between these groups while taking into account a broad range of characteristics. Furthermore, wage comparisons are refined further by disaggregating apprentices into four mutually exclusive groups, defined on the basis of program completion and certification.

The results show that apprenticeship completers have higher hourly wages than apprentices who discontinue their programs. Without conditioning on other variables, the difference is about 21%. Apprentices who complete their programs **and** obtain certification have statistically higher wages than those who do neither—a difference of about 25%. Apprentices who either completed their programs **or** obtained certification (but not both) also have statistically higher hourly wages than those who neither completed nor certified. Finally, among those who completed their apprenticeship programs, those who obtained certification have hourly wages about 12% higher than those of apprentices who did not.

1 Introduction

Over the last decade, there has been growing interest in apprenticeship programs in Canada. This is likely due to a number of factors, including concerns about current and possible future shortages of skilled tradespersons and increasing emphasis on the capacity of apprenticeship programs to offer rewarding careers to young Canadians, including those who are not university-bound.

Between 1995 and 2007, the number of Canadians enrolled in apprenticeship programs more than doubled, from 163,370 to 358,555.¹ However, over the same period, the number of successful apprenticeship completions increased by only about one-third, raising questions about what might account for the widening gap. The earnings gains associated with apprenticeship completion are one consideration.

The traditional way for workers to become skilled tradespeople in Canada is through apprenticeship programs, whereby employers agree to train workers on-the-job and give release time for classroom training. Workers in return accept lower wages. Individuals often enter apprenticeship programs when they are older, have family responsibilities, and possess significant labour market experience. They may complete several years of a program, becoming, for example, a third- or fourth-year apprentice, and earn the wages commensurate with that level of training. If satisfied with earnings and working conditions at that level, the apprentice may have little incentive to complete the program. Similarly, apprentices with family responsibilities or financial obligations may be reluctant to take time away from paid employment to complete the classroom training required for program completion. Apprentices may also face a disincentive to completing their programs if they are concerned their employer will be unable or unwilling to continue employing them once they are journeypersons given the higher hourly wage rate.

In this context, a small, but growing, body of research on apprentices and apprenticeship programs in Canada is emerging. Nonetheless, information on the earnings of registered apprentices—particularly the hourly wages of those who complete or those who do not complete their apprenticeship program—remains sparse, and wage differences between individuals with different completion and certification statuses have yet to be examined.

Using the 2007 National Apprenticeship Survey (NAS), hourly wage differences observed between apprentices who complete their programs and apprentices who discontinue their programs are compared by using a multivariate earnings model. The primary objective is to estimate the magnitude of the wage difference between these groups while taking into account a broad range of characteristics. Furthermore, wage comparisons are refined by disaggregating apprentices into four mutually exclusive groups, defined on the basis of program completion and certification. Compared to individuals who neither completed their apprenticeship programs nor obtained certification, individuals who either completed their programs or obtained certification received wages that were 11 log points to 17 log points higher, while individuals who both completed and obtained certification had wages that were 22 log points higher. These differences are most evident among paid employees, but less so among the self-employed.

Certification is an important consideration in the discussion of wages earned by apprentices. In most cases, registered apprentices who complete the requisite hours of experience and classroom training must also pass a final examination in order to obtain a Certificate of Qualification. This conveys the title of journeyperson, permits them to train other apprentices, and entitles them to earn a wage rate at the journeyperson level. However, not all individuals who obtain certification have completed an apprenticeship program. This is because individuals—usually those with significant work experience—who have not formally acquired the

1. Laporte and Mueller (2011).

requisite hours of experience and training can challenge the final examination and, if successful, obtain their Certificate of Qualification. These individuals are called "trade qualifiers." In some cases, trade qualifiers have never been enrolled in an apprenticeship program.

Using the Registered Apprenticeship Information System^{2,3} (RAIS) for 2007, Desjardins (2010b) reported that 18,341 persons obtained a Certificate of Qualification as trade qualifiers in 2007. This compares with 24,000 persons who obtained a Certificate of Qualification after having completed an apprenticeship program. Although it would be informative to estimate wage differentials between individuals who obtain their Certificate of Qualification as trade qualifiers and those who do so through a registered apprenticeship program, information making it possible to do so is not available. The RAIS is the only data source in Canada that includes all trade qualifiers, but it does not contain information on their hourly wages or other socio-demographic characteristics. Consequently, this paper examines only individuals who have been registered in an apprenticeship program.

The paper is organized into several sections. A review of the Canadian literature on the earnings of apprentices is presented in Section 2. The data and descriptive statistics are presented in Section 3, and the methodology used and the multivariate results are presented in Section 4. Conclusions are presented in Section 5.

2 Background and literature review

Compared to those for other forms of postsecondary education, such as college and university, the requirements for advancing through and completing apprenticeship programs tend to be highly varied. The most recent version of the Ellis Chart—which compares apprenticeship programs across all 13 Canadian jurisdictions—lists close to 400 apprenticeships.⁴ Different programs have different requirements for classroom and on-the-job training. Minimum hours and years of training and work experience required for program completion vary as well. Other program requirements may also differ. For example, some trades are compulsory in that one must be a registered apprentice or a journeyman in order to work in that field (e.g., electricians).

The Canadian literature on the earnings differences between individuals who do and individuals who do not complete apprenticeship programs is sparse. Akyeampong (1991) used the 1989–1990 National Apprenticeship Survey (NAS) and showed that, 12 months following program completion or termination, apprentices who had completed their programs earned about 5% more per hour than those who had not. Using the 2007 NAS, Ménard *et al.* (2008) found larger differences, including median wages of apprentices who had completed their programs 35% higher than those of apprentices who had discontinued their programs (\$27 and \$20 per hour, respectively). In terms of earnings, Ménard *et al.* (2008) showed that apprenticeship completers are more likely than discontinuers to have annual earnings above various thresholds. Also using the 2007 NAS, Malatest *et al.* (2011) found that apprentices who complete their programs and receive a Certificate of Qualification earn \$61,900 per year on average, compared with \$51,200 for those who complete without certification and \$55,100 for those who do not complete their apprenticeships.⁵ However, none of these studies takes into

2. For more information, see the *Registered Apprenticeship Information System (RAIS) Data Element Manual*, at http://www.statcan.gc.ca/imdb-bmdi/document/3154_D1_T4_V2-eng.htm#fn1.

3. The data collected in Quebec by the RAIS come from only two sources: the Commission de la construction du Québec and Emploi-Québec. The data from Emploi-Québec include only information on regulated trades. Also, the RAIS has no information on programs in the automotive sector. As a consequence, there is undercoverage of the apprentices and trade qualifiers in that province.

4. See www.ellischart.ca.

5. It is unclear whether those who did not complete their programs did or did not have certification. The former option is the most likely given the results below and the fact that the same data are used in both cases.

account other factors that may influence earnings comparisons between completers and discontinuers, such as age, education obtained prior to apprenticeship, regional labour market conditions, or trade-specific factors. Furthermore, hourly wages provide a more useful measure of compensation than annual earnings, since wages do not include the confounding effects of annual hours worked.

In contrast to the simple comparisons noted above, Boothby and Drewes (2006) estimated a multivariate model of weekly earnings using 2001 Census data. They estimated the weekly earnings of 25-to-34-year-old males with a trades certificate (and a high school diploma) to be about 15-percentage-points higher than the weekly earnings of those with only a high school diploma. For females, the comparable figure is 4.5 percentage points, statistically insignificant. However, because of data limitations, Boothby and Drewes were not able to compare the earnings of individuals who completed apprenticeship programs and those of individuals who did not. In more recent work, Boothby and Drewes (2010) used the 2006 Census to compare the earnings of individuals with a trades certificate to the earnings of individuals with other levels of education, ranging from less than high school to post-graduate university degrees. Their multivariate model contains a set of independent variables commonly used in this type of analysis. They found that men with a trades certificate have weekly earnings 17% higher than those of men with only high school, but that women with a trades certificate have weekly earnings about 3.5% lower than those of their counterparts with high school. As a result of data limitations again, Boothby and Drewes were not able to compare the weekly earnings of individuals who completed an apprenticeship program and those of individuals who did not.

Overall, apprenticeship wage studies have presented either descriptive statistics or comparisons across broad educational categories. Given the many questions regarding the returns to apprenticeship completion, closer inspection of individuals who complete their programs and individuals who do not is warranted. The analysis below focuses on these two groups and compares the earnings differences that remain when observable characteristics are taken into account.

3 Data and descriptive statistics

3.1 Data

Statistics Canada's 2007 National Apprenticeship Survey (NAS) contains information on the training and employment of apprentices across Canada. The sampling frame consists of all apprentices on the apprenticeship registration lists for the years 2002, 2003, and 2004 provided by 12 of the 13 provincial and territorial jurisdictions (Nunavut being the exclusion). A total of 30,572 respondents were interviewed. The survey was conducted between January and May 2007.⁶

The survey comprised apprentices in three states: those who had completed apprenticeship program requirements (completers); those whose were registered in 2004 and had begun their programs in 1999 or earlier (long-term continuers); and those who were registered at some point but withdrew from their programs prior to completion (discontinuers). The status of these individuals could (and often did) change between the 2002–2004 frame and the 2007 survey. Completers and discontinuers are included in this analysis since wage and income data were collected only from these two groups. Each individual in the sample was also asked questions about his or her socio-demographic characteristics, pre-apprenticeship education, training and

6. The 2006 census did ask specific questions regarding apprenticeship training and wages, and has a large sample size for analysis. However, it lacks the information on completion and discontinuation of apprenticeship programs. The RAIS is useful for the fact that it is administrative—not survey—data and therefore is likely to have fewer measurement errors and broader coverage. However, these data have limited background variables.

work experience, types of work, difficulties encountered during his or her apprenticeship program, and other experiences and characteristics.

The survey also contains postal code information at the time of registration and at the time of the survey. Using Statistics Canada's Postal Code Conversion File Plus (PCCF+) and the Labour Force Survey, respondents were assigned the unemployment rate in their economic region on the grounds that local labour market conditions may affect wages.

A limitation of the NAS data is the limited coverage of registered apprentices in Quebec, since only the construction trades in that province are represented on the sampling frame. According to the *Microdata User Guide: National Apprenticeship Survey 2007* (Statistics Canada 2008), comparisons between Quebec and the other provinces should be avoided unless restricted to similar trades. This analysis takes specific trades into account, and estimates were run both including and excluding Quebec. The results were very similar in both cases, and those presented below include Quebec.

A number of restrictions were imposed on the sample. Respondents who indicated an inconsistent apprenticeship status between 2002–2004 and 2007 were removed,⁷ as were those who reported different trades between 2002–2004 and 2007, those who had not worked at all as apprentices between 2000 and 2007, inclusively, those who started their apprenticeship programs before age 16 or were over age 80 at the time of the survey, and those who had missing values on key variables used in the analysis. Furthermore, since wages are the focus of this analysis, respondents who held no job in the week prior to the survey,⁸ those employed as unpaid family workers, and those with unknown, very low (i.e., less than \$500) or very high annual income (i.e., more than \$500,000) were removed, as were those with unknown or very high hourly wages (i.e., more than \$500). The final sample consists of 18,399 observations—representing about three times that many Canadians registered in apprenticeship programs between 2002 and 2004 who had either completed or discontinued their programs by 2007.

3.2 Descriptive statistics

Summary statistics comparing the characteristics of completers and discontinuers are presented in Table 1. In the sample, females comprise a larger share of completers, perhaps because females are overrepresented in relatively short programs such as hairstyling. Completers are considerably more likely than discontinuers to be married (55.1% and 43.7%, respectively) and have, on average, more children under age 18. Completers also tend to have higher levels of pre-apprenticeship education, as evidenced by the proportions with high school or above. Discontinuers have spent fewer years in their programs on average, with about 64% spending two years or less in their apprenticeships before leaving. In contrast, about 74% of completers complete their programs within 3 to 10 years, with most completing in 3 to 5 years. Notable trade groups are carpenters and cabinetmakers, which have a relatively large proportion of discontinuers (compared to this group's proportion of completers), and hairdressing, which has a relatively large proportion of completers (compared to this group's proportion of

7. For example, individuals who said they had completed their programs in 2002–2004 but reported they were "discontinuers" in 2007. Around 900 observations were deleted from the sample because of inconsistency in the change in their status between 2002–2004 and 2007. The difference could be attributable to a real change in status, errors in the administrative data from the 13 jurisdictions, or errors on voluntary survey responses from apprentices.

8. Around 2500 observations were deleted from the sample as a result of this restriction. Consequently, the model was also estimated using a Heckman two-step procedure to account for selectivity into employment. The results were very similar to those presented here.

discontinuers).⁹ Provincial differences are also evident, with completers overrepresented (relative to discontinuers) in Ontario and underrepresented in Quebec and Alberta.¹⁰

Annual incomes and hourly wages are both higher, on average, among completers than among discontinuers, although more variance is evident among the latter. Completers are less likely than discontinuers to be self-employed, are more likely to work in permanent jobs, and are less likely to work part-time. Completers are more likely than discontinuers to have the same employer upon exiting their apprenticeship programs. This is to be expected since many trades are compulsory and since one must be either an apprentice or a journeyperson in order to work in the field. Thus, the discontinuation of an apprenticeship program can mean automatic removal from the trade. Of the apprentices who completed their programs, 90% also obtained certification, while 10% did not. Conversely, 90% of apprentices who discontinued their programs did not obtain certification, while 10% of apprentices who discontinued their programs did so.

In Table 2, average hourly wages are shown for completers and discontinuers in detailed trade groups, disaggregated by whether or not certification was obtained. Across the entire sample, average hourly wages are highest among individuals who completed their programs and obtained certification (\$28.07), and only slightly lower among those who discontinued their programs but obtained certification nonetheless (\$27.25). Individuals who completed their programs but did not obtain certification had average hourly wages \$3 to \$4 lower than those of these two groups (at \$23.92), while individuals who discontinued their programs and were not certified had the lowest average hourly wage (at \$23.30). Quite clearly, regardless of program completion, average hourly wages are highest among individuals who have received a Certificate of Qualification, although within detailed trade groups the pattern can differ.

9. This result for carpenters and cabinetmakers is due in part to the fact that all observations from Quebec are from this trade group. Excluding Quebec yields a similar result, with this trade group having a disproportionately low share of completers.

10. Again, this result for Quebec is driven entirely by the fact that all observations from Quebec are for the construction trades and that carpenters and cabinetmakers have a high rate of discontinuation in all jurisdictions.

Table 1
Summary statistics, completers and discontinuers, 2007

Variable	Completers		Discontinuers	
	mean	standard deviation	mean	standard deviation
Male	0.897	0.304	0.914	0.280
Female	0.103	0.304	0.086	0.280
Age in 2007	33.4	7.502	33.4	8.705
Marital status at end				
Married	0.551	0.497	0.437	0.496
Divorced	0.041	0.198	0.054	0.226
Single	0.408	0.492	0.509	0.500
Number of children less than 18 years old	0.690	1.027	0.627	1.023
Aboriginal	0.037	0.189	0.054	0.226
Visible minorities	0.054	0.226	0.044	0.204
White	0.909	0.288	0.902	0.297
Immigrant	0.075	0.263	0.061	0.240
Disability at beginning	0.025	0.155	0.033	0.180
Education				
Less than high school	0.114	0.318	0.154	0.361
High school	0.490	0.500	0.448	0.497
Trade-vocational	0.112	0.315	0.132	0.339
College	0.223	0.416	0.208	0.406
University	0.062	0.240	0.057	0.233
Number of years in program				
Less than 1 year	0.027	0.163	0.266	0.442
1 year	0.056	0.231	0.224	0.417
2 years	0.096	0.295	0.150	0.357
3 years	0.173	0.378	0.084	0.278
4 years	0.214	0.410	0.057	0.232
5 years	0.143	0.350	0.044	0.205
6 to 10 years	0.208	0.406	0.104	0.305
11 to 15 years	0.048	0.213	0.036	0.186
16 to 20 years	0.020	0.141	0.021	0.142
More than 20 years	0.014	0.119	0.016	0.124
Detailed trade groups				
Non-coded	0.010	0.100	0.009	0.092
Automotive service	0.119	0.324	0.092	0.289
Bricklayer and mason	0.015	0.121	0.032	0.175
Carpenter and cabinetmaker	0.093	0.290	0.171	0.377
Crane operator	0.016	0.125	0.011	0.103
Early-childhood educator	0.005	0.071	0.005	0.074
Electrician	0.175	0.380	0.150	0.357
Electronics	0.006	0.077	0.011	0.103
Food service	0.036	0.185	0.039	0.194
Hairstylist and esthetician	0.074	0.262	0.031	0.173
Heavy-duty equipment mechanic	0.065	0.246	0.047	0.211
Heavy-equipment operator	0.009	0.092	0.010	0.099
Industry instrument technician	0.011	0.102	0.023	0.149
Interior finish	0.013	0.113	0.036	0.185

See notes at end of table.

Table 1**Summary statistics, completers and discontinuers, 2007**
(concluded)

	Completers		Discontinuers	
	mean	standard deviation	mean	standard deviation
Lather	0.008	0.089	0.024	0.154
Machinist	0.055	0.227	0.036	0.186
Metal worker (other)	0.022	0.147	0.020	0.139
Millwright	0.050	0.217	0.027	0.163
Other trades	0.021	0.142	0.021	0.145
Partsperson	0.009	0.097	0.007	0.082
Plumber, pipefitter, and steamfitter	0.086	0.281	0.094	0.291
Refrigeration and air-conditioning mechanic	0.023	0.149	0.018	0.132
Roofer	0.008	0.087	0.020	0.140
Sheet metal worker	0.022	0.148	0.027	0.161
Welder	0.051	0.220	0.042	0.200
Province				
Newfoundland and Labrador	0.014	0.118	0.018	0.133
Prince Edward Island	0.003	0.059	0.001	0.028
Nova Scotia	0.024	0.154	0.018	0.132
New Brunswick	0.023	0.151	0.023	0.151
Quebec	0.164	0.370	0.278	0.448
Ontario	0.312	0.463	0.176	0.381
Manitoba	0.037	0.188	0.029	0.167
Saskatchewan	0.047	0.211	0.036	0.187
Alberta	0.260	0.439	0.311	0.463
British Columbia	0.113	0.316	0.105	0.307
Territories	0.003	0.057	0.005	0.067
Various background or employment factors				
Annual income (dollars)	59,203	31,414	49,429	33,675
Hourly wage (dollars)	27.67	12.29	23.70	13.57
Certification	0.904	0.295	0.101	0.302
Self-employment	0.121	0.326	0.147	0.354
Part-time work	0.023	0.149	0.056	0.231
Multiple jobs	0.096	0.294	0.082	0.275
Job status				
Permanent	0.807	0.394	0.753	0.431
Temporary	0.049	0.215	0.054	0.227
Seasonal	0.021	0.144	0.042	0.200
Don't know	0.002	0.043	0.003	0.059
Union member at end	0.315	0.464	0.325	0.468
Different language at home and work	0.068	0.251	0.087	0.282
Same employer as apprenticeship	0.464	0.499	0.202	0.401
	Completers		Discontinuers	
Diagnostic statistics				
Unweighted sample size (number)		15,553		2,846
Weighted sample size (number)		50,222		11,103
Proportion of total		0.819		0.181

Source: Statistics Canada, National Apprenticeship Survey.

Table 2

Average hourly wages by major trades, completers and discontinuers

Variable	Hourly wages in dollars							
	Certification				No certification			
	Completers		Discontinuers		Completers		Discontinuers	
	mean	standard deviation	mean	standard deviation	mean	standard deviation	mean	standard deviation
Detailed trade groups								
Non-coded	27.16	9.30	x	x	26.14	10.92	27.14	7.75
Automotive service	23.63	9.57	21.77	7.85	21.25	11.79	19.72	9.97
Bricklayer and mason	29.49	12.75	20.60	10.26	23.47	9.14	23.55	14.66
Carpenter and cabinetmaker	27.88	9.52	24.19	7.48	26.79	12.66	23.69	14.31
Crane operator	35.82	15.15	x	x	30.62	16.46	32.28	13.95
Early-childhood educator	18.32	6.10	x	x	x	x	15.41	7.79
Electrician	31.13	9.55	30.91	16.88	26.95	13.95	24.24	13.89
Electronics	27.33	8.72	x	x	24.25	16.26	19.72	8.54
Food service	17.51	6.72	16.95	7.65	18.40	11.50	17.67	7.51
Hairstylist and esthetician	15.34	7.96	17.99	18.03	13.79	7.01	15.76	7.43
Heavy-duty equipment mechanic	28.89	11.60	28.53	8.82	28.41	14.17	23.16	14.31
Heavy-equipment operator	25.74	7.90	26.33	15.43	20.89	5.56	28.97	29.60
Industry instrument technician	40.99	20.90	x	x	40.14	20.03	37.90	16.02
Interior finish	27.40	10.50	x	x	23.39	8.00	20.83	7.77
Lather	28.77	9.74	20.61	7.15	27.35	7.08	20.98	12.72
Machinist	26.73	8.17	21.92	4.24	22.94	6.88	20.88	9.20
Metal worker (other)	31.48	11.46	30.67	6.81	28.59	15.25	22.02	8.51
Millwright	31.59	9.68	29.65	4.89	26.77	14.13	26.60	11.34
Other trades	23.93	8.73	26.60	12.09	20.35	8.27	20.64	10.24
Partsperson	25.09	9.41	x	x	25.78	8.87	25.10	9.01
Plumber, pipefitter, and steamfitter	31.94	11.24	38.23	20.98	30.41	24.53	24.42	13.63
Refrigeration and air conditioning mechanic	31.66	9.22	28.38	10.82	28.71	16.04	23.09	9.87
Roofer	28.34	8.98	24.05	10.89	29.11	22.81	20.27	7.27
Sheet metal worker	29.15	7.46	27.41	10.18	26.54	9.20	23.28	11.94
Welder	35.83	20.89	46.61	31.77	29.83	15.74	29.20	16.41
Total	28.07	12.07	27.25	15.43	23.92	13.69	23.30	13.29
Diagnostic statistics	Certification				No certification			
	Completers		Discontinuers		Completers		Discontinuers	
Number of observations	14,288		312		1,265		2,534	

Note: Statistics are weighted.

Source: Statistics Canada, National Apprenticeship Survey.

4 Methodology and results

4.1 Econometric estimations

The descriptive statistics above do not control for any factors that may be correlated with hourly wages, such as age or specific trade. In this section, a series of multivariate regression models of hourly wages are estimated by taking into account a broad range of respondents' observable characteristics. The dependent variable in the models is the natural logarithm of hourly wages.¹¹ The first regression focuses on differences in hourly wages observed among program completers and discontinuers, using the following format:

$$\ln(\text{hourly wages}) = \beta_0 + \beta_1 \text{COMPL} + \varepsilon \quad (1)$$

where the β_s are coefficients to be estimated. *COMPL* is a categorical variable indicating whether the observation is for a completer (*COMPL*=1) or a discontinuer (*COMPL* =0) in 2007.¹²

The subsequent regressions have the following format:

$$\begin{aligned} \ln(\text{hourly wages}) = & \beta_0 + \beta_1 \text{CERTI} * \text{COMPL} + \beta_2 \text{NO_CERTI} * \text{COMPL} \\ & + \beta_3 \text{CERTI} * \text{NO_COMPL} + \beta_4 \text{TRADES} + \beta_5 X_i + \varepsilon \end{aligned} \quad (2)$$

CERTI is a categorical variable indicating whether certification was obtained (*CERTI*=1) or not (*CERTI*=0). Interacting this variable with the completion variable (*COMPL*) yields four mutually exclusive categories: certified completers, noncertified completers, certified discontinuers, and noncertified discontinuers (the omitted group). These variables are included in the model in order to capture wage differences observed across the four groups. Note that the earnings estimate is not an internal rate of return since it does not take into account differences in costs associated with apprenticeship completion.¹³

TRADES is a vector of mutually exclusive and dichotomous variables representing one of the 25 unique trades groups in the National Apprenticeship Survey (NAS) (e.g., electrician, hairstylist, heavy-duty equipment mechanic, etc.).

The vector *X* contains socio-economic variables, including the following: sex, age (entered as a quadratic), marital status, Aboriginal status, visible-minority status, immigrant status, disability status at the beginning of the program, pre-apprenticeship education, grades in high school, language, unemployment rate in the economic region of residence, part-time work, multiple job holding, job status, union, and province or territory (with all territories included as one).

The econometric model was estimated by using the method of ordinary least squares (OLS) with robust standard errors and controlling for clustering at the provincial level.¹⁴

11. Regressions using the natural logarithm of annual income in place of hourly wages were also performed and yielded similar results.

12. The analysis could have been performed for the three states, i.e., completers, discontinuers, and long-term continuers. Unfortunately, labour force information on wages and income for the long-term continuers was not available.

13. See Heckman *et al.* (2008) for more details on the differences between earning premiums and internal rates of return.

14. Median regressions were also attempted owing to the fact that those who do not complete their programs have a wider wage distribution (see Table 1), since they are disproportionately represented at the top of the wage distribution (more than \$100 per hour) and, especially, at the bottom (wages less than \$10 per hour). The median regression results were similar to those presented here and do not change the conclusions.

Estimating returns to apprenticeship implies the same concerns as estimating returns to any type of education. There may be selection on unobservables that could bias the OLS estimators. In our case, those who completed their apprenticeship programs in the sample may differ in unobserved ways that affect wages, while this may not be the case with those who discontinued their programs. That is to say, completers may have abilities that discontinuers do not have, but these abilities are not observed. If these abilities are positively correlated to wages, then OLS estimates of the returns to apprenticeship completion will be biased upwards. A number of researchers attempting to estimate the returns to education have dealt with this potential bias issue: for example, some have used natural experiments such as fixed-effects estimator on a sample of identical twins (Ashenfelter and Krueger 1994).

The debate remains about the magnitudes of the bias, but recent studies have shown that the upward bias tends to be modest (Card 1999, 2001, and Gunderson 2009). In the case of returns to apprentices, Fersterer *et al.* (2007) estimated returns to apprenticeship training in Austria for apprentices in failed firms. They argued that, when a firm fails, it manipulates the length of the apprenticeship period completed for some apprentices. Therefore, the time of firm failure serves as an instrument for the length of apprenticeship completion. They found that using the instrumental methods or OLS returns yields similar results indicating little or no bias in OLS estimates. In any case, the results in this paper should be viewed as upper bounds on the actual returns to apprenticeship completion.

4.2 Results

Results from the first model, which include only the dummy variable identifying completers and discontinuers, are presented in Model 1 of Table 3. A difference of about 19 log points is observed between groups, indicating that completers have hourly wages almost 21% higher than discontinuers, on average.¹⁵ Results from the second model (Model 2, Table 3) refine this by estimating hourly wages in terms of both completion and certification. Individuals who neither completed their programs nor obtained certification (i.e., noncertified discontinuers) are the reference group. Relative to them, the hourly wages of certified completers are 22 log points (or 25%) higher, while the hourly wages of certified discontinuers are 14 log points (or 15%) higher. The difference of 8 log points between certified completers and certified discontinuers is not statistically significant. Among apprentices who did not obtain certification, there is no significant difference between those who completed their programs and those who discontinued them. However, this difference becomes statistically significant and larger once other variables are taken into account.

Indicators for trade groups are added in Model 3. This is important since some trades are regulated or compulsory. This means that an individual must be a registered apprentice or a journeyperson in order to work in the field (e.g., plumbers and electricians).¹⁶ With the trades identifiers included, the hourly wages of certified completers and certified discontinuers increase to almost 25 log points and 18 log points, respectively (again relative to noncertified discontinuers), while noncertified completers have hourly wages 11 log points higher.

15. Log points are converted to percentages by using the formula $y = (e^x - 1) \times 100$, where x is the number of log points and y is the corresponding percentage. In this case, $(e^{0.19} - 1) \times 100 = 20.7$. This same methodology is employed throughout the remainder of the paper.

16. Data from the Ellis Chart on compulsory trades in Ontario were merged with the NAS in an attempt to see whether there also exists a premium to completion and/or certification in these trades. No such evidence was found.

Table 3
Wage regressions

Variable	Regression on hourly wages (natural logarithm)							
	Model 1		Model 2		Model 3		Model 4	
	coefficient	standard error	coefficient	standard error	coefficient	standard error	coefficient	standard error
Completers	0.188 **	0.028						
Certification × completers			0.222 **	0.025	0.246 **	0.020	0.220 **	0.008
No certification × completers			0.017	0.027	0.109 **	0.019	0.107 **	0.011
Certification × discontinuers			0.142 **	0.042	0.179 **	0.043	0.170 **	0.053
Trade groups (carpenter and cabinetmaker)								
Non-coded					0.006	0.036	0.021	0.053
Automotive service					-0.184 **	0.030	-0.140 **	0.030
Bricklayer and mason					0.000	0.024	0.021	0.021
Crane operator					0.228 **	0.018	0.167 **	0.018
Early-childhood educator					-0.433 **	0.026	-0.229 **	0.038
Electrician					0.096 **	0.026	0.090 **	0.026
Electronics					-0.083 †	0.042	-0.127 *	0.043
Food service					-0.411 **	0.022	-0.333 **	0.021
Hairstylist and esthetician					-0.638 **	0.044	-0.452 **	0.031
Heavy-duty equipment mechanic					0.019	0.045	0.027	0.032
Heavy-equipment operator					-0.054 †	0.030	-0.016 †	0.008
Industry instrument technician					0.400 **	0.023	0.317 **	0.034
Interior finish					-0.043	0.038	-0.027	0.021
Lather					-0.031	0.020	-0.024 **	0.007
Machinist					-0.047 *	0.021	-0.011	0.029
Metal worker (other)					0.097 **	0.026	0.070 **	0.022
Millwright					0.124 **	0.016	0.126 **	0.028
Other trades					-0.168 **	0.034	-0.113 *	0.037
Partsperson					-0.074 **	0.022	-0.107 **	0.022
Plumber, pipefitter, and steamfitter					0.110 **	0.026	0.075 **	0.023
Refrigeration and air-conditioning mechanic					0.110 **	0.032	0.106 *	0.035
Roofer					-0.025	0.022	0.000	0.025
Sheet metal worker					0.045	0.026	0.031	0.027
Welder					0.173 **	0.021	0.115 **	0.017
Male							0.140 **	0.008
Age in 2007							0.011 **	0.002
Age squared divided by 1000							-0.153 **	0.037

See notes at end of table.

Table 3
Wage regressions (continued)

	Regression on hourly wages (natural logarithm)							
	Model 1		Model 2		Model 3		Model 4	
	coefficient	standard error	coefficient	standard error	coefficient	standard error	coefficient	standard error
Aboriginal							-0.049 **	0.004
Visible minorities							-0.053 *	0.020
Marital status at end (married)								
Divorced							-0.050 **	0.007
Single							-0.047 **	0.005
Immigrant							-0.025 *	0.011
Disability at beginning							-0.062 *	0.027
Education (high school)								
Less than high school							-0.021 *	0.008
Trade-vocational							-0.004	0.011
College							0.014	0.009
University							0.032 †	0.017
Province (Ontario)								
Newfoundland and Labrador							-0.142 **	0.032
Prince Edward Island							-0.240 **	0.016
Nova Scotia							-0.193 **	0.010
New Brunswick							-0.226 **	0.005
Quebec							-0.058 **	0.019
Manitoba							-0.029 **	0.009
Saskatchewan							-0.008	0.008
Alberta							0.169 **	0.009
British Columbia							0.081 **	0.007
Territories							0.229 **	0.052
Various background or employment factors								
Part-time work							-0.068 **	0.009
Multiple jobs							-0.001	0.008
Union member at end							0.118 **	0.021
Constant	3.047 **	0.056	3.033 **	0.055	3.041 **	0.037	2.688 **	0.073

See notes at end of table.

Table 3
Wage regressions (concluded)

	Model 1	Model 2	Model 3	Model 4
Diagnostic statistics				
Number of observations	18,399	18,399	18,399	18,399
<i>R-squared</i>	0.028	0.045	0.284	0.344

**p<0.01

*p<0.05

†p<0.10

Notes: Also included: number of years in the program, different language at home and work, same employer as apprenticeship, unemployment rate, job status, and high school grades. Data cells are left blank when variables are not included in a model. Omitted categories appear in parentheses.

Source: Statistics Canada, National Apprenticeship Survey.

Finally, results from the model containing all the regressors, including socio-economic characteristics, province of residence, regional unemployment rates, etc., are shown in Model 4. The results for the four groups change little with these variables added. Again, relative to noncertified discontinuers, the hourly wages of certified completers and certified discontinuers are 22 log points and 17 log points higher, while those of noncertified completers are again 11 log points higher. Comparing apprentices with certification, the difference between certified completers and certified discontinuers is 5 log points in the final model, and remains statistically indistinguishable from zero.

To highlight the differences between the four groups, the coefficients from Model 4 in Table 3 are presented somewhat differently in Table 4 and Table 5.¹⁷ Specifically, wage differences associated with certification are presented in percentage terms for completers and discontinuers (Table 4), while wage differences associated with completion are presented for apprentices who obtain or do not obtain certification (Table 5).

Table 4
Wage differentials associated with certification

	Associated with certification				
	sample proportion	coefficient value	premium value	standard error	p-value
Completers	0.975	0.11	11.92	0.02	0.000
Discontinuers	0.024	0.17	18.57	0.05	0.008

Note: Wage differentials to completion and certification are similar when Quebec is excluded from the sample.

Source: Statistics Canada, National Apprenticeship Survey.

Table 5
Wage differentials associated with completion

	Associated with completion				
	sample proportion	coefficient value	premium value	standard error	p-value
Certification	0.904	0.05	5.09	0.05	0.379
No certification	0.096	0.11	11.34	0.01	0.000

Note: Wage differentials to completion and certification are similar when Quebec is excluded from the sample.

Source: Statistics Canada, National Apprenticeship Survey.

17. These calculations were also made for Model 4 in Table 3 without Quebec included and by using median regressions instead of OLS. In both cases, the results did not change markedly.

Results in Table 4 show that completers who obtain certification ($\beta_1 - \beta_2$) have hourly wages about 12% higher than completers who do not. Among apprentices who discontinued their programs, those who obtained certification (β_3) have hourly wages about 19% higher than those who did not. Table 5 shows that the completion premium is 5% (not significant) for those with certification ($\beta_1 - \beta_3$) and 11% for those without (β_2).

To further investigate wage differences, respondents are divided into those who are self-employed and those who are paid employees. The rationale is that the incentives to completing an apprenticeship program and/or obtaining certification may be different for the self-employed and paid employees. For paid employees, program completion and certification may be important signals that demonstrate their skills to prospective employers. This may not be the case for the self-employed since they work for themselves. However, the extent to which tradespersons, including the self-employed, may forego certification is limited to non-compulsory trades. Pyper (2008) showed that rates of self-employment were much higher in non-compulsory than compulsory trades in 2007.¹⁸ Of the respondents included in our sample, 22.5% were self-employed.

Table 6 shows how wages between the self-employed and employees differ. Some interesting patterns emerge. First, the mean wages of the self-employed exceed those of employees. In some cases, the difference is substantial (e.g., compare certified discontinuers). Second, there is much more variation in wages for the self-employed as evidenced by the higher standard deviations. Although the self-employed comprise just over one-fifth of the sample, they account for about one-third of respondents earning less than \$10 per hour and for almost one-half of those earning more than \$100 per hour. This is reflected in the higher mean wages and lower median wages relative to paid employees. Third, those with certification have higher mean wages than those without, regardless of self-employment or completion status. Finally, in all but one case (the certified self-employed), the wages of completers exceed those of discontinuers.

Table 6
Hourly wages, self-employed and employees, by completion and certification status

	Hourly wages in dollars								
	Employees			Self-employed			Total		
	mean	median	standard deviation	mean	median	standard deviation	mean	median	standard deviation
Certification									
Completers	27.79	27.90	10.12	30.24	25.00	21.64	28.07	27.53	12.07
Discontinuers	25.87	25.00	12.47	34.35	25.57	24.83	27.25	25.00	15.43
No certification									
Completers	22.96	21.00	11.57	28.81	24.50	20.83	23.92	21.31	13.69
Discontinuers	22.62	20.00	11.43	27.30	21.67	20.73	23.30	20.14	13.29
Total	26.57	26.11	10.71	29.63	24.50	21.50

Note: Statistics are weighted.

Source: Statistics Canada, National Apprenticeship Survey.

18. For example, carpenters, masons, and other construction trades had self-employment rates of 25.3%, 31.6%, and 39.2%, respectively. This compares to rates for electricians of 6.8% and for plumbers of 12.1% (both of which are compulsory trades).

To examine these differences more closely, Table 7 and Table 8 contain estimates comparable to those in Table 4 and Table 5.¹⁹ The objective is to assess whether hourly wage differences observed across completion and/or certification status vary between the self-employed and paid employees. Among employees who have completed their programs, hourly wages are about 13% higher for those with certification than for those without while among employees who have not completed their programs, the difference is close to 17%. Among the self-employed, there is no statistically significant difference observed among completers and discontinuers who have or have not obtained certification. This lack of statistical significance, however, is likely due to the smaller number of self-employed in the sample.

Table 7

Wage differentials associated with certification, self-employed and employees

	Associated with certification							
	Self-employed				Employees			
	coefficient value	premium value	standard error	p-value	coefficient value	premium value	standard error	p-value
Completers	0.05	5.60	0.06	0.405	0.12	13.13	0.02	0.000
Discontinuers	0.20	21.85	0.17	0.277	0.15	16.73	0.03	0.000

Note: Wage differentials to completion and certification are similar when Quebec is excluded from the sample.

Source: Statistics Canada, National Apprenticeship Survey.

Table 8

Wage differentials associated with completion, self-employed and employees

	Associated with completion							
	Self-employed				Employees			
	coefficient value	premium value	standard error	p-value	coefficient value	premium value	standard error	p-value
Certification	0.00	-0.11	0.13	0.994	0.06	6.32	0.03	0.098
No certification	0.14	15.27	0.04	0.007	0.09	9.70	0.01	0.000

Note: Wage differentials to completion and certification are similar when Quebec is excluded from the sample.

Source: Statistics Canada, National Apprenticeship Survey.

Observed wage differences associated with completion are positive and significant at least at the 10% level for employees, and range from 6% to 10%. Among the self-employed who have not obtained certification, hourly wages are 15% higher among those who completed their programs than among those who did not. Among the self-employed who have obtained certification, no significant wage difference is observed between those who have completed their programs and those who have not.

19. The full estimates on which these results are based are contained in Table 9 and Table 10. Owing to the wider wage distribution and the differences between median and mean wages—mainly among the self-employed—the models were also estimated by using median regressions. There were no substantive changes in the results presented here.

5 Conclusion

Apprenticeship completion is an important positive correlate of hourly wages among tradespersons in Canada. Previous studies have presented descriptive evidence showing that hourly wages and annual incomes are higher among apprentices who complete their programs than among those who discontinue.²⁰ This study adds to this literature by examining wage differences associated with completion in a multivariate framework.

This study finds that apprenticeship completers have higher hourly wages than apprentices who discontinue their programs; this is consistent with results from previous studies. Without conditioning on other variables, the difference is about 19 log points (or 21%). Disaggregating apprentices into four groups on the basis of program completion and certification refines the wage comparisons. Apprentices who complete their programs **and** obtain certification have statistically higher wages than those who do neither—a difference of about 22 log points (or 25%). Apprentices who either complete their programs **or** obtain certification (but not both) also have statistically higher hourly wages than those who neither completed nor certified—differences of 11 log points to 17 log points. Finally, among those who completed their apprenticeship programs, those who obtained certification have hourly wages about 11 log points (or 12%) higher than those of individuals who did not obtain certification.

The same general pattern holds when the sample is disaggregated into paid employees and the self-employed, although many of the differences among the self-employed do not achieve statistical significance, although this is likely due to the larger standard errors resulting from smaller sample size.

20. Other studies that have employed a multivariate framework have been able to show only the premium to apprenticeship completion compared to other levels of education such as high school and college.

6 Appendix

Table 9

Wage regressions, self-employed and employees, Models 1 and 2

Variable	Regression on hourly wages (natural logarithm)							
	Model 1				Model 2			
	Self-employed		Employees		Self-employed		Employees	
	coefficient	standard error	coefficient	standard error	coefficient	standard error	coefficient	standard error
Completers	0.079 †	0.041	0.206 **	0.026				
Certification × completers					0.106 *	0.037	0.240 **	0.026
No certification × completers					0.051	0.063	0.008	0.024
Certification × discontinuers					0.175	0.166	0.134 **	0.028
Constant	3.119 **	0.089	3.035 **	0.050	3.099 **	0.074	3.021 **	0.052

Diagnostic statistics	Model 1		Model 2	
	Self-employed	Employees	Self-employed	Employees
Number of observations	2,125	16,274	2,125	16,274
R-squared	0.003	0.039	0.005	0.064

**p<0.01

*p<0.05

†p<0.10

Note: Data cells are left blank when variables are not included in a model.

Source: Statistics Canada, National Apprenticeship Survey.

Table 10
Wage regressions, self-employed and employees, Models 3 and 4

Variable	Regression on hourly wages (natural logarithm)							
	Model 3				Model 4			
	Self-employed		Employees		Self-employed		Employees	
	coefficient	standard error	coefficient	standard error	coefficient	standard error	coefficient	standard error
Completers								
Certification × completers	0.163 **	0.022	0.255 **	0.022	0.197 **	0.053	0.216 **	0.013
No certification × completers	0.117 †	0.056	0.105 **	0.014	0.142 **	0.043	0.093 **	0.009
Certification × discontinuers	0.175	0.151	0.172 **	0.023	0.198	0.173	0.155 **	0.028
Trade groups (carpenter and cabinet maker)								
Non-coded	-0.002	0.147	0.008	0.032	-0.125	0.164	0.034	0.040
Automotive service	-0.316 **	0.046	-0.171 **	0.034	-0.315 **	0.033	-0.120 **	0.032
Bricklayer and mason	-0.135 *	0.060	0.029	0.023	-0.063	0.075	0.044 *	0.017
Crane operator	0.420 **	0.082	0.212 **	0.023	0.316 **	0.083	0.161 **	0.027
Early-childhood educator	-0.644 **	0.052	-0.421 **	0.028	-0.540 **	0.076	-0.191 **	0.038
Electrician	0.013	0.037	0.106 **	0.031	-0.015	0.049	0.101 **	0.030
Electronics	-0.665 **	0.188	-0.027	0.057	-0.793 **	0.192	-0.055	0.050
Food service	-0.358 *	0.142	-0.412 **	0.035	-0.346 †	0.173	-0.315 **	0.033
Hairstylist and esthetician	-0.605 **	0.061	-0.642 **	0.044	-0.602 **	0.046	-0.419 **	0.041
Heavy-duty equipment mechanic	0.049	0.071	0.017	0.048	-0.004	0.055	0.032	0.035
Heavy-equipment operator	-0.092	0.053	-0.047	0.027	0.033 †	0.018	-0.018	0.010
Industry instrument technician	0.390 **	0.088	0.403 **	0.020	0.270 **	0.046	0.331 **	0.033
Interior finish	0.011	0.077	-0.059	0.036	0.054	0.083	-0.051 *	0.021
Lather	0.075 *	0.028	-0.060 *	0.025	0.117 *	0.039	-0.059 **	0.017
Machinist	0.065	0.061	-0.052 *	0.022	0.065	0.048	-0.011	0.027
Metal worker (other)	-0.040	0.125	0.105 **	0.028	-0.070	0.134	0.078 **	0.023
Millwright	0.232 **	0.074	0.121 **	0.020	0.171 **	0.050	0.126 **	0.027
Other trades	-0.242 **	0.055	-0.156 **	0.033	-0.236 **	0.058	-0.092 *	0.038
Partsperson	-0.009	0.049	-0.074 **	0.024	-0.179 *	0.062	-0.095 **	0.029
Plumber, pipefitter, and steamfitter	0.134 †	0.075	0.108 **	0.023	0.079	0.077	0.074 **	0.023
Refrigeration and air-conditioning mechanic	0.014	0.124	0.121 *	0.042	0.004	0.127	0.119 *	0.042

See notes at end of table.

Table 10

Wage regressions, self-employed and employees, Models 3 and 4 (concluded)

Regression on hourly wages (natural logarithm)								
	Model 3				Model 4			
	Self-employed		Employees		Self-employed		Employees	
	coefficient	standard error	coefficient	standard error	coefficient	standard error	coefficient	standard error
Roofer	0.023	0.243	-0.028	0.031	0.080	0.198	-0.007	0.013
Sheet metal worker	-0.056	0.137	0.061 †	0.030	-0.111	0.141	0.051 †	0.026
Welder	0.361 **	0.049	0.120 **	0.022	0.266 **	0.033	0.074 *	0.025
Constant	3.104 **	0.065	3.032 **	0.035	2.699 **	0.312	2.701 **	0.047

	Model 3		Model 4	
	Self-employed	Employees	Self-employed	Employees
Diagnostic statistics				
Number of observations	2,125	16,274	2,125	16,274
R-squared	0.187	0.332	0.240	0.406

**p<0.01

*p<0.05

†p<0.10

Notes: All variables from Table 3 are included in this table but are not necessarily shown. Omitted categories appear in parentheses. Data cells are left blank when variables are not included in a model.

Source: Statistics Canada, National Apprenticeship Survey.

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